
REPORT AND ESTIMATES,
RELATIVE TO THE
ENLARGING of the HARBOUR of LEITH

WITH
PLANS of a BASON above *Leith-mills*, and another between
the *North Pier* and the *Citadel*, with SECTIONS of parts of the
Work.

BY
ROBERT WHITWORTH, Esq; Engineer.

Edinburgh, November 7th 1786.

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ENLARGING OF THE HARBOUR OF LEITH

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PLANS OF A BASIN
the New Pier and the
Sections of part of the
Work



BY

ROBERT WHITEWORTH ESQ. Engineer

Edinburgh, Glasgow and London

TO THE RIGHT HONOURABLE
THE LORD PROVOST,
MAGISTRATES, AND TOWN-COUNCIL
OF THE
CITY OF EDINBURGH.

MY LORD AND GENTLEMEN,

IN obedience to your orders and directions, I have taken a survey of the Harbour of Leith, and have likewise taken the levels of all the adjacent country, where there can be any probability of extending the Harbour, supposing the entrance to be by the present Pier, which, in my opinion, it ought to be; and I suppose it will be the opinion of all who are acquainted with the situation of the place, and nature of this kind of business.

As it was once proposed to make a Bason in the Links, I took the level of that ground, and found it from seven to ten feet above an ordinary spring-tide; so that, to make it to low water, the mean depth of digging would not be less than 24 feet; consequently, to make a Bason of any considerable dimensions, would be exceedingly expensive, as the earth and till dug out, must be carried to a considerable

derable distance. Indeed, the quantity would be so great, that it would not be easy to find room to deposite it: but the greatest difficulty would be, in making a Canal of Communication with the present Harbour, as it would be between 500 and 600 yards long, and would, of necessity, pass through yards, gardens, and pleasure-ground, and would occasion many good houses and other buildings to be taken down. These are obstructions that did not exist, to the same degree, at the time it was formerly proposed, (about 30 years ago), as they do now; so that, whatever it was then, it cannot now be an eligible scheme, especially as there are *two others*, either of them being, in my humble opinion, far more eligible, and of greater utility.

THE *one* is, to make a Wet Bason in the low grounds to the south of Leith-mills, between the Bonnington-road and the river; the *other* is, to make either a Wet or Dry Bason upon the Sands of North Leith; both which are represented upon the Plan.

AND, *first*, I will consider the proposition of making a Wet Bason in the low ground to the south of the river, above Leith-mills.

PREPARATORY to the making a Bason here, it will be necessary to deepen the bed of the river, to give the ships a passage to it; and, to give the better idea of the necessity and consequence of deepening it, and of the depth it ought to be made, I have taken the levels, and drawn a profile of the bed of the river, from the point of the South Pier, to the foot of the dam at Leith-mills; also of the bed of the river and ground above the dam, where the Bason is proposed to be made. The scale by which I have laid down the length of this profile, is 200 feet in an inch, but the scale of height is only 20 feet in an inch, which it was necessary to do, otherwise the rise could not be made perceptible.

By

By this profile, it appears, that, if the deepening commences a little below the Bridge, and be made to the depth of the red line, up to the Lock that must be built to lift the ships into the Bason, it would give about *seven feet* water in ordinary neap-tides, and about *thirteen feet* in ordinary spring-tides. This I would not propose to drive up *quite level*, but let it have a rise of about *one foot* in the whole space, (which is about 600 yards): This would drain the water better from the workmen. Neither should it be dug to a flat bottom, but be made in the form of a segment of a circle, about 40 feet wide, and two feet deeper in the middle than at the sides. This would give the scouring-water from the Bason a more powerful effect in cleansing out any sediment, gravel, &c. that may have settled in the channel, as it would confine it to a narrower compass.

THERE can be no difficulty in performing this part of the business, if you take the opportunity to do it in the dry part of the Summer. At that time, I suppose, the water will not incommode the workmen very much in digging it up. Yet, if it be not very hard till, or rock, it may be cut by a ballast-machine, at any time of the year, and at any time of tide.

As you have not given me any directions respecting the size it may be proper to make a Bason for the reception of ships, (supposing this scheme should be adopted), I have planned out as large a one as the low ground can well admit of; and this I have done in two different forms, but both of the same size. Each will contain about 35,000 superficial yards of surface water, which is equal to 7.2 English acres, or 5.7 Scotch acres, which perhaps may be larger than there may at present be occasion for. But, as the expence of deepening the river, erecting a Draw-bridge, and building a Lock, to lift ships from the bed of the river into the Bason, will be

be the same, whether the Bason be large or small; and as it will be necessary for me to have some *data* to build my calculations upon, I will, for the present, suppose it to be of the size I have represented upon the plan: but this you may reduce at pleasure; and, as it will be solid digging, the estimate of the expence will be reduced much in the same proportion.

IN both these plans, I have confined them to the lowest grounds as much as possible; a great part of which is very little higher than the dam-head, consequently must be marshy, and of small value; but the part that would be covered with the earth dug out, and which must be occupied by the wharfs, warehouses, *building-slips*, &c. is for the most part good garden ground.

IN one of these schemes, (represented by figure 1.) I have proposed the Bason to consist of a long square, about 450 feet by 300, and of two branches of 150 feet wide each, the one 700 feet long, the other 450.

THIS, I think, would be a convenient form for a Bason, the two wings or branches being wide enough to contain four tiers of ships, and leave a commodious passage in the middle.

BUT if the expence of the quay or wharf walls be thought too much, they being near 1100 yards in length, (exclusive of the dam-wall to separate the Bason from the river), it may be made in the form represented by figure 2. which will be of equal capacity, and the expence of digging will be nearly the same.

THE length of the quay walls would be only 750 yards, consequently there would be a saving of 350 yards in length, which will greatly reduce the expence.

IN both, I have supposed them to be dug to the depth of *ten feet* below the dam-head; so there would be ten feet water, without the least interference with Bonnington mill; and this may easily be done to this depth, as it may be drained (without pumping) by making a cut through the green, below the wash-house, and turning the river on the west side of the dam, and likewise paying the miller temporary damages during the execution of the work. Yet, perhaps, it may be advantageous to have more than ten feet water. Suppose twelve feet be thought a proper depth, the easiest way to obtain it, would be to pen two feet upon the tail of Bonnington-mill; for the earth, &c. dug out to make ten feet depth below the dam-head, will raise the ground sufficiently high for the quays; but if more than that depth be wanted, it would be best to take the water from the head of Bonnington mill; by which, 14 or 15 feet water may be obtained at the same expence of digging: but there will be damages to pay to the mills for loss of water. This I mention for your consideration; yet, in my calculations, I will confine myself to ten feet deep, without interfering with Bonnington-mill at all: But I cannot steer so clear of Leith mills; for the water to lift the ships out of the river into the Basin, must be taken from these mills. This has been mentioned as almost an insurmountable objection, as the whole Water of Leith, in dry seasons, will not be sufficient for this purpose; and, of course, the mills rendered useless during those times of scarcity: Yet, when the real quantity that may reasonably be supposed to be wanted comes to be considered, and in some measure ascertained, which I trust it may be, then, perhaps, this objection will not appear so formidable. Neither do I think it at all necessary to be at the expence of building both a *large* and *small Lock*, in order to save the expenditure of water, but to build one Lock, of dimensions sufficient to take in the largest ships that it may be expected will be carried to this proposed Basin. This, I suppose, should be about 130 feet long, and 34 feet wide.

A Lock of these dimensions will expend 123 tons of water for every foot of perpendicular height it lifts a ship. Now, a ship coming upon the top of an ordinary spring-tide, will require to be lifted about five feet, (see the Profile); consequently will expend 615 tons of water. This is a quantity that will work an ordinary undershot corn-mill about nine or ten minutes; (but as I did not measure the quantity the saw-mills take, I do not know how long it will work them); and this quantity of water would take one ship up and another down, or as many small vessels as the Lock would hold.—Vessels coming in or going out of the Basen in neap-tides, will require to be *lifted*, or *let down*, 11 or 12 feet; consequently, each lockful will expend about 1400 or 1500 tons of water. This would work a mill about 25 minutes.—I do not know how many ships may pass in a day to and from the Basen: But supposing there be three to pass up, and as many down; in spring-tides, they would expend about half an hour's water of a good corn-mill, and, in neap-tides, rather more than double that quantity; and, if the gates be kept in good repair, the leakage from them will be inconsiderable, so that the expenditure of water will not be so great as might have been apprehended, supposing the Basen and Gates be made watertight, which I think there is but little difficulty of doing, though it has not been so thoroughly examined by boring as I could wish; but, from what has been done, it appears to be soft, to eight, or in some places, ten feet deep, but, in most places, is hard firm ground, a foot or two before it come to the depth the Basen is proposed to be dug; so that there is great probability of having a good foundation for the quay-walls, without piling, and that the digging will be easy. Indeed, the whole of this business will be easy to execute, as it may be so completely drained, that the workmen will not be in the least interrupted by the tide, either in digging out the Basen, or building the quay-walls. But, in laying the foundation of the Lock, and the wing-walls below, the water may be
troublesome

troublesome and expensive, as the fill of the Lock must be laid nearly as low as the bed of the river below the bridge: Yet I do not apprehend much difficulty here, if the bed of the river be first deepened.

THE dam or wall to separate the river from the Bafon, I would propose to consist of two parallel walls, with cross, or tie-walls, between them, at the distance of 30 feet; the space between them to be filled with earth, and that a part or rib about three feet thick, in the middle of it, be well rammed or puddled, and sunk into the natural ground, till it be incorporated with the earth, clay, or till, below, so as to prevent any leakage.

A PLAN and section of this wall or dam, also a plan and section of the quay-wall, I have drawn at the bottom of the plan, to which I would beg leave to refer. These walls I suppose should be six feet thick at bottom, and four at top, the front of the wall to fall back two feet, and to have a counterfort at the distance of every 30 feet, in each of which should be laid a tie of timber, represented by *a, b*, (both in the plan and section), to bind the wall and counterfort together, to enable it the better to sustain the pressure of soft earth behind. The wall to be 15 feet high above the bottom of the Bafon, as the earth dug out will raise the ground to that height; and the whole height from the foundation may in general be about 16 feet. But this will altogether depend upon the nature of the ground, which is rather uncertain, as it has not yet been regularly bored; but if any part be soft where the walls are to stand, it may be made permanent and secure by piling, as represented upon the sections. The softness of the ground must regulate the length of the piles.

IN the former part of this report, I observed, that the water necessary for locking the ships *into*, and *out of* the Bafon, must be taken from Leith mills; and it perhaps may be thought proper to remove the mills altogether to the other side of the river, (where there is a good situation for them), rather than they should work from the water of the Bafon, *as navigators and millers seldom agree*: Yet I do not at present see any great objection to their remaining in the situation they now stand, and drawing the water of the river through the Bafon, provided there be a fill so placed, that they cannot draw the water down lower than a certain *number of inches*, that may be agreed upon. The only objection remaining, would be, the danger of the gravel and sand coming from the river, and lodging in the west end of the Bafon; yet, if the fill of the sluice that feeds the Bafon be placed high, that is, two or three feet above the bed of the river, and, in time of flood, be close shut down, I do not think it would occasion much inconvenience, I mean, not enough to make it an object to remove the Mills; for the little gravel or sand that might settle, may easily be taken out with a small ballast-engine, without taking the water out of the Bafon. These objections being so far removed, I will suppose the Mills to remain quietly in their present situation, till it be found by experience to be more eligible to remove them.

BEFORE I quit this subject of Mills, I will just observe, that, in case the water be penned two feet upon the tail of Bonnington-mill, in order to make *twelve feet* water in the Bafon, it will raise the head or fall of Leith-mills two feet, which would be greatly advantageous to them. But, if the water be taken from the head of Bonnington-mill, in order to make *fourteen or fifteen feet* water in the Bafon, then the head of Leith-mills would be increased *four or five feet*, which would increase their power so much, that it would more than counterbalance any loss they might sustain in furnishing water for locking
ing

ing the ships up and down; in which case, the compensation for water would entirely ly with the owners of Bonnington-mill.

THIS Bason, I suppose, would conveniently hold 120 sail of shipping; and they would be well sheltered from the wind; so that they would be quite safe in the most stormy weather: and it is well calculated to scour out the present Harbour, and deepen the channel over the bar. The way to give it the greatest effect, would be, to fill the Lock, and discharge it from the lower gate, in which I would have six sluices, whose apertures, taken together, should be 36 superficial feet, consequently, would give a column of water equal to six feet square; and this, at the first setting out, would be discharged with a velocity of 32 feet *per second*, which will give 1920 tons of water in a minute. But the *mean velocity*, during the whole discharge of the Bason, will be 25 feet and a half *per second*, which will discharge 1530 tons in a minute.

THE whole content of the Bason, at only ten feet deep, (which, added to the height of the breast of the Lock, gives the *head*, upon which the foregoing calculations are made), is 87,500 tons, which, at 1530 tons *per minute*, will be discharged in 57 minutes.

THIS prodigious quantity of water being let off about an hour and half before low water, in spring-tides, will most powerfully and effectually scour and cleanse the bed of the river from the tail of the Lock to the point of the South Pier. To this place it will be confined to a narrow compass, which will give it great effect; but from hence it will have liberty to spread, by which it will lose a great part of its power, before it reaches the bar; yet, by making use of a ballast-machine, or some other means, to cut away the obstructions, it perhaps may be, in some measure, confined in a proper direction; which if it can, it will soon make an alteration in the depth

of the channel at the bar; at least, it is the most likely way to effect it: but, as I did not go out in a boat to examine this part minutely, I cannot just now say what method may be most proper to be taken.

THE expence of making the above mentioned Bafon, and the other work described above, may be nearly as set down in the following estimate.

An ESTIMATE of the EXPENCE of making a WET BASON in the Low Grounds between the *Leith River* and the *Bennington Road*, on the South side of the *Leith Mills*, to contain 35,000 superficial Yards of surface Water, or a little more than seven English statute Acres: Also, DEEPENING the BED of the RIVER, from a little below the Bridge to the Dam above the Mills, to the Depth represented upon the Profile; and Erecting a LOCK, to lift the Ships from the Bed of the River into the said proposed Bafon.

In this estimate, I will confine myself to ten feet depth of water, below the head or level of the present dam, and to the form represented by Figure 2. in the plan.

TO 178,520 cubic yards of digging, to form the Bafon, including the foundation of the quay-walls, and also the foundation of the dam-wall, that is to separate the Bafon from the river. This, as far as has been discovered by boring, appears to be soft and easy to dig, to within two or three feet of the bottom, and then some of it will be hard till. I suppose,

pose, one half of it will be dug, and wheeled to a proper distance, for 4 d. *per* cubic yard; but, in digging the bottom part, as the workmen may be a little troubled with water, and some of it will be till, or some hard matter, it may cost 6 d. *per* cubic yard: Therefore, the mean price is 5 d. *per* cubic yard, which comes to

L. 3719 3 4

To building 750 yards running of quay-wall, which, at a mean, will be about 16 feet high, six feet thick at bottom, and four feet at top; this will contain $277\frac{1}{2}$ roods, (of 24 cubic yards each). The face of this wall to be rough broached ashler, with band stones of three feet and half long at the least, at the distance of eight feet in every course; the inside to be rubble-work, with headers to overlap those in the front ashler; with a coping four feet broad, and nine inches thick; the whole to be set in mortar. The price of this work, in this country, I do not exactly know; but, suppose about 7 l. *per* rood; at which rate, it comes to

1942, 10 0

To 75 counterforts, such as represented upon the plan and section.—In these there will be near 23 roods, which, including the timber-ties, I will suppose at the same rate *per* rood; which comes to

161 0 0

To building a water-tight dam, composed of two parallel walls, to separate the Bafon from the river, agreeable to the section before mentioned, drawn at the bottom of the plan, (supposing no piles wanted).—This wall will be about 164 yards in length, and will contain about 95 roods and half of walling; which, at the aforesaid rate of 7 l. *per* rood, comes to

668 10 0

Carry over L. 6491 3 4

	Brought over	L. 649	3	4
To filling up the space between the said walls with earth, and incorporating the middle part of it with the natural earth, and ramming or puddling a rib up the middle of it (as represented upon the section), to make it completely secure and water-tight, which will be necessary; otherwise, when the Bason is empty, the river would break in upon it.—This will require 2170 cubic yards; but as it will be dug out of the Bason, it is as easy to bring here, as carry any where else; therefore, there will be only the expence of puddling, which may cost 3 d. <i>per</i> yard				
			27	2 6
To extra expence in making a sluice in the dam, to let the water into the Bason, and another to let it out again to the mill				
			60	0 0
To land that it may be proper to purchase for the Bason, and likewise for wharfs, warehouscs, ship-building, and other purposes.—What the proper quantity may be, I am no judge of; but suppose the space contained within the red dotted lines, <i>a, b, c, d, e, f</i> , be sufficient, the quantity will be about 18 acres; about six acres of which is wet marshy ground, which perhaps may cost about 40 l. <i>per</i> acre; the remaining 12 is good pasture or garden ground, which may cost 100 l. <i>per</i> acre.—At these rates, it comes to				
			1440	0 0
To deepening the bed of the river, from the Bridge to the proposed Lock, in the manner before described, to the depth of the red line in the profile; also digging the foundation of the Lock.—In this work there will be about 8,820 cubic yards, which, as a				
	considerable	-----		
	Carry over	L. 8018	5	10

Brought over L. 8018 5 10
 considerable part of it must be taken into barges,
 (either by ballasting or otherwise), and carried a-
 way to some distance, it may cost 1 s. *per* cubic
 yard, which comes to 441 0 0

To building a Lock, to lift the ships from the bed of
 the river into the Bason. This, if built with wing-
 walls to the extent represented upon the plan and
 profile, with an inverted arch, will contain 165
 roods of masonry, which, upon account of the situa-
 tion, may merit about 10 l. *per* rood.—Into this
 work, I suppose it will be best to bring, and make
 use of, the materials of the old bridge, which will
 pay for taking it down, and clearing out the bot-
 tom, 1650 0 0

To timber and iron work for the gates, &c. 440 0 0

To making a temporary dam to keep off the water,
 and pumping the water during the time of laying
 the foundation 200 0 0

To making a Draw-bridge.—The most proper place
 for this bridge, I apprehend, would be at the New
 Quay; and if it be made with an opening of 36
 feet, with a 30 feet arch on each side, I suppose it
 will give sufficient water-way; yet, of this I am
 not certain; neither do I know what sort of foun-
 dation there is; therefore, cannot say with cer-
 tainty what the expence would be; yet, from the
 rough calculations I have made, I suppose it will
 come to about 1500 0 0

To temporary damages to Leith Mills, which, of ne-
 cessity, must be deprived of water, during the time
 of _____

D

Carry over L. 12,249 5 10

Brought over	L. 12,249	5	10
of the execution of the Lock and Bafon, which, perhaps, may be two years; suppose	(200	0	0
To loss of water after the works are completed, either to Leith or Bonnington Mills, or to both, (see page 8th of the preceding report); suppose	400	0	0
To impediments to works, unforeseen accidents, supervisal, &c. also piling the foundation of the Quay-Wall and Dam, if wanted, (which is uncertain); suppose 10 per cent. upon the whole	1284	18	7
	L. 14,134	4	5

I COME now to consider the proposition of inclosing a Wet Dock or Bafon, upon the sands of North Leith, by a Pier, from the end of the North Pier, to the east end of the Citadel. This I have proposed to be built in form of the segment of a circle, struck with the radius of *one thousand feet*; this form will give it the greatest strength it can have, so as to enable it the more effectually to resist the violence of the waves, which will beat most furiously against it. By the trial that has been made by boring, it appears to be a good foundation of hard till, and, if built agreeable to the plan and section drawn at the bottom of the general plan, there can be no doubt but it will withstand the most violent tempests that can be expected to come against it. The worst thing against this Bafon is, its being exposed to the north wind; so that the light ships being afloat in it, may ly uneasy, and be beat one against another in stormy weather: Yet I should think, a good deal of this objection may be removed, by raising the parapet wall of the Pier very high. I have calculated it to 16 feet above a spring-tide; but the form and strength of the Pier is such, that it may, with safety, be raised to the height represented.

ented by the dotted lines, which is 18 feet above a spring-tide, or even higher, if found necessary.

If this Bason be made to the dimensions represented upon the Plan, it will contain about 11 Scotch acres, or about 13 acres and an half English: And this, I humbly apprehend, would be of more public utility if made into a Wet Bason; for this reason, because, if it be suffered to fill and empty itself every tide, it would, in time, fill up, or be greatly reduced in depth, by the foul tide-water dropping its silt and mud, with which it comes loaded; and there is no back-water to scour it out, nor can any be had, except by inclosing a part of itself, and making it into a Wet Bason, to scour out the other part, in the manner that has been done at Ramsgate, and some other places; and to keep this inner Bason clear, will be attended with a considerable annual expence: So that, upon the whole, it may be nearly as expensive as making a Wet Dock at once. To complete it in this manner, it will be necessary to build a strong wall, parallel to the North Pier, and the space between them filled with earth, to be incorporated with clay and till below, to as great a depth as a trench can be dug; for the North Pier is not strong enough to sustain the pressure of the head of water; neither can it be expected that the foundation is at all calculated for that purpose, if the Pier itself was strong enough.

AND, to make this work complete, it will be necessary to make a Lock, or double pair of Gates, to admit the ships into, or out of the Bason; for, upon the falling off of the tides, after the spring-tides, a single pair of Gates cannot be opened, till the water within be brought down to the level of that without, which would be attended with a good deal of trouble and inconvenience.

THE expence of making this Wet Dock, or Bason, may be nearly as follows:

**An ESTIMATE of the EXPENCE of making a
WET DOCK, or BASON, upon the Sands of *North Leith*, (con-
taining 11 Scotch Acres), in the Form represented upon the Plan.**

To making a Pier Wall, from the north end of the North Pier to the north end of the Citadel, being 450 yards in length, agreeable to the Plan and Section drawn at the bottom of the General Plan.— This Pier will contain 1140 roods of masonry, to be composed of large stones, such as is represented upon the Section. The price of stone and labour in this country I do not exactly know, but suppose it may cost about 10*l.* *per* rood, which comes to 11,400 0 0

To making an inner-wall parallel to the North Pier, at a proper distance, to inclose or contain a bank of earth to make it water tight.—This will take 92 roods of masonry, but will not require to be made in the same firm manner, or of such large stones, as the above; therefore, it may perhaps be done at about 8*l.* *per* rood, - - - 736 0 0

To 44,660 cubic yards of earth, to be well rammed between the tie or cross-walls that bind the parallel walls of the Pier together, to be incorporated with the natural clay or till below, so as to make the Piers completely water tight, at 6*d.* *per* yard, 1116 10 0

Carry over L. 13,252 10 0

	Brought over	L. 13,252 10 0
To 4500 tons of <i>whin</i> , or any other kind of rubble-stone, to be laid upon the outside of the Pier, in the form shewn upon the section, to guard it from the violence of the waves, suppose at 1s. <i>per</i> ton,		225 0 0
To making a quay-wall along the shore, about seven feet below high-water mark, from the north end of the Citadel, to the east end of the North Pier, being 380 yards in length, to be 16 feet high, six feet thick at bottom, and four feet at top, with counterforts at every 30 feet, (the same as in the other proposed quay-wall); this will contain 152 roods, which, at 8l., comes to		1216 0 0
To digging and clearing out the sand, to the depth of 12 feet below the high-water of an ordinary spring-tide; in this there will be about 62,000 cubic yards of sand, &c. part of which to be wheeled to level up the ground behind the quay-wall, the other to be taken up into barges, and carried to the outside of the Pier; this, if sand, will be done at about 3d. <i>per</i> cubic yard,		775 0 0
To making a Lock or Double Sluice, to enable the ships to pass in and out of the Bafon, at all times, when there is <i>depth of water</i> .—This Lock, if made with an inverted arch, will contain about 140 roods of masonry, which at 12l. <i>per</i> rood, comes to		1680 0 0
To making a temporary dam to keep off the neap-tides, during the time of laying the foundation, and pumping the water,		400 0 0
To timber and iron work,		440 0 0

E.

Carry over L. 17,988 10 0

Brought over	L. 17,988 10 0
To unforeseen accidents, impediments to works, pile- engines, pumps, and other utensils, supervisal, &c.	
suppose 10 per cent. upon the whole	1,798 17 0
	L. 19,787 7 0

THE above are the best calculations I have been able to make, from the imperfect knowledge of the price of the stone; and not being completely certain as to the foundation in every part. Yet, with regard to the proposed Bason above Leith mills, if I be right in the price of materials, I can speak with some kind of confidence, that I believe the Estimate will be sufficient to complete the work, it being a kind of work that I have been long acquainted with. But of the other proposition, of making a Wet Bason upon the sands of North Leith, I cannot be so certain, as it is altogether in the tide's way; yet, it is so plain, that I think I cannot be much mistaken.

I am, with the greatest respect,



My LORD, and GENTLEMEN,

Your very humble servant,

NOVEMBER 7th
1786.

ROBT. WHITWORTH.